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EPR and optical spectroscopy of Yb3+ ions in CaF2: An analysis of the structure of tetragonal centers

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Abstract

CaF2 crystals doped with Yb3+ ions have been studied by electron paramagnetic resonance (EPR) and optical spectroscopy. EPR spectra of paramagnetic centers (PCs) for cubic (Tc) and tetragonal (T tet) symmetries were identified. Empirical energy level diagrams were established and crystal field parameters were determined. Information on the CaF2:Yb3+ phonon spectra was obtained from the electron-vibrational structure of the optical spectra. The crystal field parameters were used to analyze the crystal lattice distortions in the vicinity of the Yb3+ ion. Within the framework of a superposition model, it is established that four F- ions located symmetrically with respect to the fourfold axis from the side of the ion-compensator approach the impurity ion and deviate from the PC axis. The second set of four fluorine ions also approaches the Yb3+ ion and the PC axis. The ion-compensator F - also approaches considerably the impurity ion.